

# LaB6 and Iodine Resistant Miniature Cathodes for Small Thrusters, Phase I

Completed Technology Project (2018 - 2019)



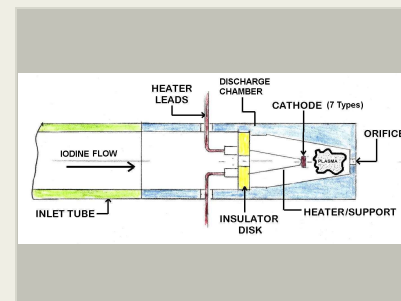
## Project Introduction

Seven miniature cathodes are offered in unique support and discharge structures with heaters and in keeper assemblies for use in thrusters for small satellites and CubeSats. Cathode candidates include LaB6, hafnium carbide, scandate, barium oxide coated tungsten, thoriated tungsten, tantalum and yttria-coated iridium. Each cathode will be constructed, tested, and evaluated in a xenon and iodine discharge environment. All tests will be performed on planar cathodes using e beam's unique cathode support structure, which incorporates support and heater in the same element. The assembly is extremely power efficient, dissipating less than 4 watts even on the high-temperature cathodes. It allows rapid construction of cathodes and keeper assemblies for multiple tests. Hafnium carbide is the most refractory binary compound known and has been successfully tested at e beam, inc. The hafnium carbide and LaB6 cathodes will be single-crystal planar, 0.040-inch in diameter. Micro-thrusters are needed for CubeSats and other small satellites. Over 2,000 small satellites are planned over the next 10 years, but small, low-cost, efficient cathodes are not available, especially iodine compatible cathodes. E beam, inc. specializes in small cathodes and is a leader in scandate cathode research.

## Anticipated Benefits

NASA is developing a number of ion and Hall thrusters under 1 kW for small satellites and CubeSats. Miniature, low cost, efficient cathodes are needed for these thrusters. Expected demand: 2,000 to 2,750 satellites in the next 5 years.

CubeSats are the configuration of choice for university and private space research. They need low cost, efficient micro-thrusters for orbit raising/lowering, and attitude and position control. Constellations of CubeSats flying in formation with synthetic aperture radar for earth big data imaging are currently underway. This is a potential market for very small thermionic cathodes. Our innovation is ideal for this application.



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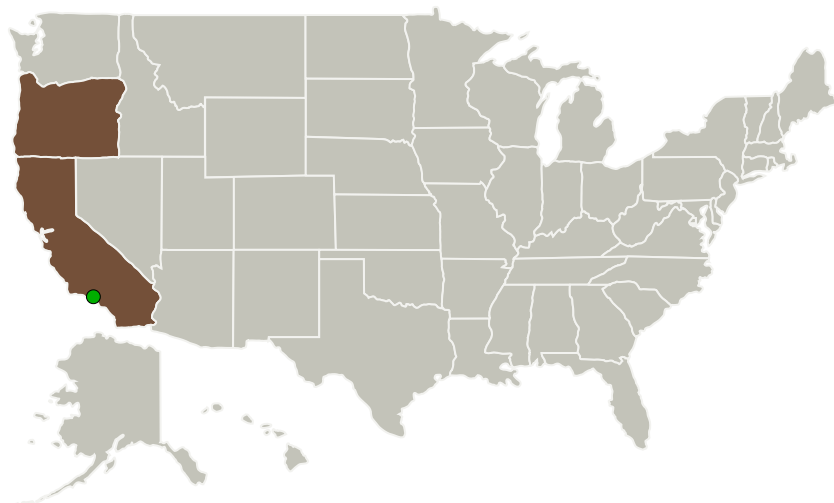
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
e-beam, Inc.	Lead Organization	Industry Veteran-Owned Small Business (VOSB)	Beaverton, Oregon
● Jet Propulsion Laboratory (JPL)	Supporting Organization	NASA Center	Pasadena, California

## Primary U.S. Work Locations

California	Oregon
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## Project Transitions

**July 2018:** Project Start**February 2019:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/141142>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

e-beam, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Principal Investigator:**

Bernard K Vancil

**Co-Investigator:**

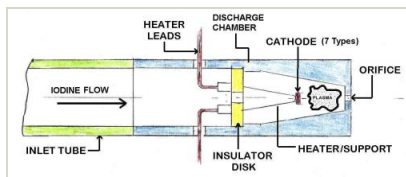
Bernard Vancil

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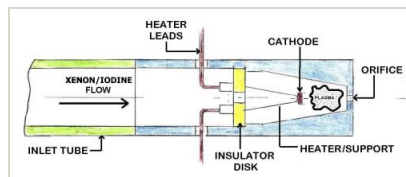
## Images



### Briefing Chart Image

LaB6 and Iodine Resistant Miniature Cathodes for Small Thrusters, Phase I

(<https://techport.nasa.gov/image/129673>)



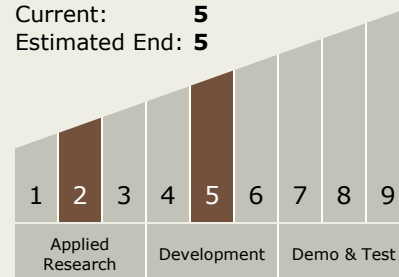
### Final Summary Chart Image

LaB6 and Iodine Resistant Miniature Cathodes for Small Thrusters, Phase I

(<https://techport.nasa.gov/image/135947>)

## Technology Maturity (TRL)

Start: 2  
Current: 5  
Estimated End: 5



## Technology Areas

### Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.1 Integrated Systems and Ancillary Technologies

## Target Destination

Earth